SUMMARY

The King County Department of Natural Resources operates and maintains two wastewater treatment plants and two combined sewer overflow treatment plants that discharge treated effluent into the central Puget Sound basin. One of King County's responsibilities is to conduct monitoring in marine waters to verify that these discharges are not degrading water quality within the vicinity of the treatment plants. The marine monitoring program has two components; point source monitoring which focuses on areas near treatment plant discharges and ambient monitoring which focuses on areas outside the immediate vicinity of known discharges. It is important to monitor areas outside the influence of point source discharges in order to assess background conditions in central Puget Sound.

In 1998, 19 offshore and 3 intertidal (nearshore) sediment stations, 5 offshore and 6 intertidal water stations, and 3 shellfish and macroalgae stations were sampled for the point source program. For the ambient program, 10 offshore and 3 intertidal sediment stations, 5 offshore and 16 intertidal water stations, 6 shellfish stations, and 4 macroalgae stations were sampled. Sediments were analyzed for organic compounds, metals, and conventional parameters with intertidal samples also being analyzed for bacteria. Water was analyzed for bacteria, nutrients, dissolved oxygen, chlorophyll, and physical parameters. Shellfish samples were analyzed for organics, metals, and bacteria. Macroalgae were analyzed for metals.

MONITORING RESULTS

Water Column

Temperature, salinity, and density values indicated a well-mixed water column throughout most of the year, but seasonal thermal stratification was evident in summer. All dissolved oxygen values were above 5.0 mg/L, the level at which potential problems could occur, with one exception. The station off West Point had a value of 4.5 mg/L at 55 meters during November--all other depths were 6.5 mg/L and above. Nutrients, such as nitrate+nitrite and ammonium, exhibited trends similar to previous years. Nitrate was most abundant in winter when not being taken up by phytoplankton and ammonium was highest in the

summer months. Major phytoplankton blooms occurred in April and July in 1998.

All offshore monitoring stations met the Washington State Class AA marine surface water standards for fecal coliform bacteria with the exception of two stations located in inner Elliott Bay. Levels at these stations met the geometric mean standard of 14 colonies/100 ml but exceeded the peak standard of 43 colonies/100 ml. The highest values for the Elliott Bay stations occurred during high rainfall periods and these sites receive higher freshwater input than other stations due to their proximity to the Duwamish River. Fecal coliform bacteria in the water column near the County's treatment plant discharges were found at low levels (usually less than 5 colonies/100 ml) if detected at all.

Fecal coliform counts at intertidal beaches are influenced by freshwater runoff from the surrounding watersheds. As a result, the number of stations exceeding the Class AA marine standards increased in the high rainfall months and at stations closer to freshwater sources. Twelve beaches exceeded both the geometric mean and peak standards; five exceeded the geometric mean but not the peak standard; and fourteen passed both standards. Beaches with the lowest bacteria counts were located near Seacrest Park and around the Duwamish Head area.

Sediment

Twelve offshore stations were sampled around the West Point Treatment Plant and six around the Carkeek Treatment Plant outfalls in order to meet NPDES requirements. Additional stations not required by NPDES requirements, including intertidal sediments, were sampled as well.

Sixteen metals were analyzed and some were either not detected (selenium and thallium) or seldom detected (antimony and silver). Arsenic, chromium, copper, lead, nickel, and zinc were detected in most samples; however, no concentrations exceeded Washington State Sediment Quality Standards (SQS) guidelines. Mercury was detected in the majority of samples and the station along the waterfront in Elliott Bay exceeded the SQS for mercury. Similar results have been obtained in previous sampling events for this station, where there is a known area of historical mercury contamination.

Of the 98 organic compounds analyzed, 24 were detected in offshore samples and 6 were detected in intertidal samples. Most of these compounds were polynuclear aromatic hydrocarbons (PAHs). Sampling generally showed the highest levels of organic compounds in the nearshore areas of Elliott Bay, however, no PAHs exceeded SQSs for these stations. One station located at the end of the West Point Treatment Plant outfall had two PAHs that exceeded SQSs: benzo(*g,h,i*)perylene and indeno(1,2,3-*c,d*)pyrene. One pesticide and three polychlorinated Aroclors (PCBs) were detected at two stations in Elliott Bay. The total PCB concentrations were below the SQS guideline. Organotins were infrequently detected in the offshore samples, with the exception of the Elliott Bay stations. Organotins, used in marine anti-fouling paints, are likely due to the proximity of these stations to the Elliott Bay Marina and ship traffic. The highest concentration, 228 µg/kg dry weight, was found at the station closest to the marina.

Three sediment toxicity tests were conducted on two of the West Point stations. The amphipod acute toxicity test passed standards for both stations. The chronic juvenile polychaete test indicated a reduction in individual and total dry weight and individual growth weight for the station at the end of the outfall but showed no reduction with respect to percent mortality for both stations. The echinoderm embryo acute toxicity test showed a significant difference between both stations and the reference station with respect to mortality and abnormal embryo development.

Shellfish

Shellfish from two point source and two ambient stations were analyzed for metals and organic compounds. Ten metals were detected and for the majority, concentrations varied only slightly between stations. State and federal criteria do not exist for acceptable levels of metals in shellfish tissues, however, the Food and Drug Administration (FDA) has established an Action Level in fish and shellfish tissues of 1.0 mg/kg for mercury. When this value is exceeded, the food product cannot be commercially traded. Mercury concentrations in shellfish were well below this Action Level. The FDA has also established guidance values termed "Levels of Concern" for mollusks for five metals: arsenic, cadmium, chromium, lead, and nickel. Shellfish results were below these Levels of Concern.

Of all the organic compounds analyzed, only benzoic acid was detected. Benzoic acid is a degradation product produced by metabolic processes and has always been detected in shellfish samples. No pesticides or PCBs were detected.

Fecal coliform concentrations varied from station to station and from month to month. Generally, stations near Seahurst and Carkeek Parks had the lowest values and the station at Alki Point had the highest value. The association between fecal coliform concentrations measured in shellfish and concentrations detected in water was examined and although there was a correlation for some stations and months, a consistent relationship was not evident.

Macroalgae

Algae samples were collected from seven stations (three point source and four ambient) and analyzed for metals. Six metals were either not detected or seldom detected. Six metals were detected in all samples (arsenic, cadmium, chromium, copper, nickel, and zinc) and no one station had consistently high values. Arsenic and copper were highest at the Magnolia station while zinc and nickel were highest at one of the West Point stations. Chromium was highest at the Richmond Beach station and cadmium highest at the Alki Point station. Concentrations detected in 1998 were similar to values detected in previous years with the exception of the nickel and zinc values at the West Point station; which were higher than previous values.